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The Genera of Plethodont Salamanders in Mexico, Pt. I.

EDWARD H. TAYLOR,

Department of Zoölogy, University of Kansas

ABSTRACT: The old genus *Oedipus* Tschudi (preoccupied by *Oedipus* Berthold, for a genus of Orthoptera, is considered as being composed of eight genera: *Chiropterotrilon* gen. nov., *Pseudoeurycea* gen. nov., *Bolitoglossa* Duméril and Bibron, *Parvimolge* gen. nov., *Thorius* Cope, *Oedipina* Keferstein, *Magnadigila* gen. nov., and *Haptoglossa* Cope.

INTRODUCTION

DURING the past twelve years, at occasional intervals, I have taken the opportunity to inquire into some of the more evident problems concerning Mexican lungless salamanders. In this length of time a rather surprising number of errors and additions to previous studies have come to light. Some have been recorded already; these and others are here summarized.

Until recently I followed Dr. Emmett Dunn in his use of the generic name *Oedipus* Tschudi for the group. Then, after Dr. Radclyffe Roberts pointed out to me that *Oedipus* Tschudi (1838) was preoccupied by *Oedipus* Berthold (1827) for an orthopteran genus, I recorded the suppression of Tschudi's name in the University of Kansas Science Bulletin, Vol. 26, No. 12, 1939 (1940), first submitting the case to the late Dr. Leonhard Stejneger, formerly a member of the International Commission on Zoölogical Nomenclature, who agreed that *Oedipus* Tschudi is not available.

In the same paper I revived Cope's genus *Thorius* for certain small Mexican salamanders, formerly associated with *Oedipus*, and used *Bolitoglossa* Duméril and Bibron for the remaining species in lieu of *Oedipus*.

A superficial examination of the numerous species of plethodontid

salamanders occurring in México, Central America and South America, showed the urgent necessity of a critical examination of these salamanders with a view of ascertaining whether Dunn was correct in lumping the thirty-one species treated in his "The Salamanders of the Family Plethodontidae" into a single genus, or whether they represented several genera and should be allocated accordingly. Early in my studies the existence of certain superspecific groups, not exactly those of Dunn, was recognized, and with the discovery of many new species by Mr. Karl P. Schmidt, Dr. L. C. Stuart, Dr. Hobart M. Smith, and myself, these groups took on more importance.

Unwilling to accept them as genera without more convincing evidence, in spite of their apparent distinctness, I embarked upon an investigation of their internal characters. In them, I found many strikingly distinctive features, correlated so completely with the groups already outlined that the existence of several genera in the *Oedipus* of Dunn (and others) became, in my opinion, an established fact.

The specimens of "*Oedipus*" which Dunn had available numbered 718, and 31 species were recognized. Compared to this number, I have examined more than eight times as many (something more than 6,000 specimens), chiefly in the collections made by Dr. Hobart M. Smith and myself, together with a considerable number of specimens in the Field Museum, Museum of Zoölogy of the University of Michigan, Museum of Comparative Zoölogy at Harvard College, American Museum of Natural History, and the United States National Museum.*

In this paper I am considering seventy-eight species † and subspecies, all known to the present, from the Americas south of the United States. This is two and one-half times the number of species recognized by Doctor Dunn. Certain of those that he did not recognize, were actually available to him, but were confused with other species. On the other hand, many have been discovered since the publication of his work. For some of the genera into which these species are here segregated, new generic names are required and are proposed herein.

It may be assumed that had all the species and material I have examined been available to him, Doctor Dunn would have arrived at much different conclusions from those expressed in his monograph.

* I desire to express my hearty thanks to the officials of these institutions who have made loans and exchanges of plethodontid salamanders and to Dr. Hobart M. Smith, who permitted me to study the material contained in the Mexican collection made by him and who has offered able advice in the preparation of this paper.

† I have seen two other species still undescribed.

The list of species recognized in this paper follows.

<i>adspersa</i> Peters	<i>macrinii</i> Lafrentz
<i>ahli</i> Unterstein	<i>melanomolge</i> Taylor
<i>alfaroi</i> Dunn	<i>mexicana</i> Duméril and Bibron
<i>altamazonica</i> Cope	<i>mosaici</i> Woodall
<i>altamontana</i> Taylor	<i>morio</i> Cope
<i>arborca</i> Taylor	<i>mulleri</i> Brocchi
<i>barbouri</i> Schmidt	<i>multidentata</i> Taylor
<i>bellii</i> Gray	<i>narisovalis</i> Taylor
<i>borburata</i> Trapido	<i>nasalis</i> Dunn
<i>bromeliacea</i> Schmidt	<i>nigroflavescens</i> Taylor
<i>cephalica cephalica</i> Cope	<i>nigromaculata</i> Taylor
<i>cephalica manni</i> Taylor	<i>occidentalis</i> Taylor
<i>cephalica rubrimembris</i> Taylor and Smith	<i>odonnelli</i> Stuart
<i>chiroptera</i> Cope	<i>paraensis</i> Unterstein
<i>chondrostega</i> Taylor	<i>parvipes</i> Peters
<i>cochranae</i> Taylor	<i>pennatula</i> Cope
<i>collaris</i> Stejneger	<i>peruviana</i> Boulenger
<i>columna</i> Dunn	<i>picadoi</i> Stejneger
<i>complex</i> Dunn	<i>platydactyla</i> Cuvier
<i>euchumatana</i> Stuart	<i>pressicauda</i> Cope
<i>dimidiata</i> Taylor	<i>pulmonaris</i> Taylor
<i>doffleini</i> Werner	<i>rex</i> Dunn
<i>dubita</i> Taylor	<i>robertsi</i> Taylor
<i>dunni</i> Schmidt	<i>robusta</i> Cope
<i>elongata</i> Schmidt	<i>rostrata</i> Brocchi
<i>englehardti</i> Schmidt	<i>rufescens</i> Cope
<i>flavimembris</i> Schmidt	<i>salvini</i> Gray
<i>flaviventris</i> Schmidt	<i>schmidti</i> Dunn
<i>franklini</i> Schmidt	<i>smithi</i> Taylor
<i>gadovii</i> Dunn	<i>striatula</i> Noble
<i>galcanae</i> Taylor	<i>subpalmata</i> Boulenger
<i>gigantea</i> Taylor	<i>sulcata</i> Brocchi
<i>goebeli</i> Schmidt	<i>terrestris</i> Taylor
<i>helmrichi</i> Schmidt	<i>townsendi</i> Dunn
<i>lavac</i> Taylor	<i>troglodytes</i> Taylor
<i>leprosa</i> Cope	<i>uniformis</i> Kesterstein
<i>lignicolor</i> Peters	<i>unguidentis</i> Taylor
<i>lincolni</i> Stuart	<i>yucatana</i> Peters
<i>lincola</i> Cope	<i>zolocae</i> Taylor

The following names have been proposed for species which have been referred to other known forms. Having seen but one of these types, I have no personal opinion as to the wisdom of certain of these synonymies. It is quite probable that some of these are good species. However, the types, if extant, will of necessity have to be carefully examined before the matter can be finally settled.

- andicola* = *adspersa* Peters (*vide* Dunn)
attitlancensis Brocchi = *salvini* Gray (*vide* Schmidt)
bocourti Boulenger = *robusta* Cope (*vide* Dunn)
bocourti Brocchi = *rostrata* Brocchi (*vide* Dunn)
carbonaria Cope = *platydactyla* Cuvier (*vide* Dunn)
copci Brocchi = *platydactyla* Cuvier (*vide* Dunn)
estheri (*Eladinea*) Ribero = *altamazonica* (*vide* Parker)

gibbicaudus Blatchley = *leprosa* Cope (Based on same type)
infuscata Peters = *lincola* Cope (*fide* Dunn)
laticeps Brocchi = *cephalica* Cope (*fide* Dunn)
minima Wiedersheim = *pennatulus* Cope (*fide* Dunn)
orecula Cope = *chiroptera* Cope (*fide* Cope)
orizabensis Blatchley = *leprosa* Cope
palmata Werner = *altamazonica* Cope (*fide* Dunn)
simus Valliant = *altamazonica* Cope (*fide* Dunn)
togata Valenciennes (*nomen nudum*)
yucatanica Boulenger = *yucatanica* Peters
punctatum = *platydactyla* Cuvier (*fide* Dunn)

REVIEW OF CLASSIFICATION SYSTEMS

In the past seventy-five years the classification of the lungless salamanders having a nasolabial groove has undergone few changes other than the addition of newly discovered species and genera. Edward Drinker Cope in 1869 presented a complete classification of the group in a paper† entitled, "A Review of the Species of the Plethodontidae and Desmognathidae." While this system was based on previous systems to some extent, Cope himself had investigated the anatomy of a great many of the forms concerned. His arrangement follows:

Family PLETHODONTIDAE

Genus <i>Plethodon</i>	Genus <i>Gyrinophilus</i>
Genus <i>Hemidactylum</i>	Genus <i>Manculus</i>
Genus <i>Batrachoseps</i>	Genus <i>Ophicobatrachus</i>
Genus <i>Stereocheilus</i>	Genus <i>Oedipus</i>
Genus <i>Anaides</i>	Genus <i>Spelerpes</i>
Genus <i>Geotriton</i>	

Family DESMOGNATHIDAE

Genus *Desmognathus*

Family THORIIDAE

Genus *Thorius*

G. A. Boulenger, in his Catalogue of the Batrachia Gradientia s Caudata and Batrachia Apoda in the collection of the British Museum, 2d Ed., 1822, pp. 51-79, treats of the same group of salamanders under two subfamilies of the Family SALAMANDRIDAE as follows:

Family SALAMANDRIDAE

[Subfamily A SALAMANDRINAE]

[Subfamily B AMBLYSTOMATINAE]

† Proc. Acad. Nat. Sci. Philadelphia, 1869, pp. 93-118.

Subfamily C PLETHODONTINAE

Genus *Anaides*Genus *Plethodon*Genus *Batrachoseps*Genus *Spelerpes*Genus *Manculus*

Subfamily D DESMOGNATHINAE

Genus *Desmognathus*Genus *Thorius*

This system lowered two of Cope's families to subfamily rank, and the third family *Thoriidae* was ignored, the genus *Thorius* being placed under the DESMOGNATHINAE.

Again in 1889 in his great monograph on The Batrachia of North America, Cope published a classification, using practically the same arrangement as was used in 1869, which recognized the DESMOGNATHIDAE, PLETHODONTIDAE and THORIIDAE as full families. The generic conceptions remained practically the same.

During the four subsequent decades both writers had their followers. As late as 1925 the Zoölogical Record was using Boulenger's subfamilies; and the Check List of North American Amphibians and Reptiles of 1922 was using Cope's arrangements and families and genera, as far as they applied to the American Fauna.

Cope (1893) apparently modified his idea of the importance of Family THORIIDAE, from that published earlier, and on the occasion of describing *Haptoglossa** referred the genus to the Subfamily THORIINAE in which he also places *Thorius* and *Oedipina*. One is in doubt as to whether it was regarded as a subfamily of the PLETHODONTIDAE or the DESMOGNATHIDAE.

In 1900 Cope's family DESMOGNATHIDAE (Boulenger's Desmognathinae) met some criticism from Percy Moore,† who endeavored to show that the group DESMOGNATHIDAE was not separable from the PLETHODONTIDAE on the basis of the character of the vertebral articulations which he erroneously believed was the only character of significance separating the two families.

In 1917 a new family, TYPHLOMOLGIDAE, was proposed by Stejneger and Barbour‡ for the genus *Typhlomolge*. Although this genus was subsequently referred to the Family PLETHODONTIDAE, these authors originally placed the family in a different suborder, the *Proteida*.

* Cope, Proc. Amer. Phil. Soc., 31, 1893, p. 334.

† Proc. Acad. Nat. Sci. Philadelphia, 1900, pp. 613-622.

‡ A Check List of North American Amphibia and Reptilia, Harvard Press, 1917.

Dunn's work on "The Salamanders of the Family Plethodontidae" is the most recent monographic treatment. In it he followed Moore by placing Cope's family DESMOGNATHIDAE in the family PLETHODONTIDAE. However, he does point out in this work many significant differences which obtain between the two groups. He states "Moore in 1900 showed that the difference between amphicoelous and opisthocelous vertebrae was a matter of individual age, and that systematic divisions based on this character were worthless."

Further, Dunn places the THORIIDAE (THORIINAE) and the TYPHLOMOLGIDAE in the synonymy of the PLETHODONTIDAE.

The classification of the Plethodontidae used is as follows:

Family PLETHODONTIDAE

Genus Typhlomolge	Genus Ensatina
Genus Typhlotriton	Genus Plethodon
Genus Hemidaetylum	Genus Gyrinophilus
Genus Batrachoseps	Genus Pseudotriton
Genus Stereochilus	Genus Eurycea
Genus Desmognathus	Genus Hydromantes
Genus Leurognathus	Genus Oedipus
Genus Aneides	

Among the generic changes proposed by Dunn, those treating of the salamanders south of the borders of the United States seem to be most open to question. Thus the genera *Oedipina*, *Oedipus*, *Haptoglossa*, and *Thorius* and certain forms referred by Cope and others to *Spelerpes*, are lumped together in the genus *Oedipus* Tschudi (preoccupied).

GENERAL CONSIDERATIONS

The salamanders of the family Plethodontidae, as interpreted by various recent authors, comprise a group extending from Alaska and Canada to Argentina and Bolivia, with a small remnant group occupying territory in Sardinia, southeastern France, and northwestern Italy. In the northern part of the range in the western hemisphere, the family has been broken up into a number of genera, about 17 being generally recognized at the present time, with some 79 species and subspecies. (Bishop, Handbook of Salamanders, 1943.)

Contrasting with this treatment in the north, most of the species occurring in México (exclusive of Baja California), Central and South America, have been thrown (following Dunn), into a single genus, which for the most part, has been recognized under the name *Oedipus* Tschudi (preoccupied by *Oedipus* Berthold for a genus of Orthoptera). The number of forms in this territory now known

number 80, and save for two, *Ensatina platensis* from Argentina and a *Batrachoseps attenuatus* in Colima, México, have been generally regarded as congeneric.

Dunn states that the large genus *Oedipus* (as he defines it) contains many extremes, and its range of variation exceeds that of most other genera so that definition of the genus is difficult—a statement which in itself strongly suggests that it is a composite. He further states that in the advent of the extinction of a few species, several genera (at least four) would be established.

Contrary to Dunn's statements, studies of the salamanders of his genus "*Oedipus*" demonstrate that he has included several generic groups, which, if all important characters are considered, form groups of equal importance and rank with the genera which he recognizes as occurring in the United States. These generic groups are not linked by annectant forms and are not "incipient" genera. If one were to unite all the plethodontid genera having a single premaxilla into a single genus or all of those having a free tongue into a genus, one would have groups no more heterogeneous than his "*Oedipus*."

Apparently Dunn made some effort to break up his genus "*Oedipus*." He arranges the species into four groups, of which he states: "They fall into the following groups, which would, if distinct enough and in the absence of annectant forms, rank as genera."

Group I. The primitive group, including*

<i>bellii</i>	<i>cephalicus</i>	<i>subpalmatus</i>	<i>chiropterus</i>
<i>schmidti</i>	<i>rostratus</i>	<i>adspersus</i>	<i>rex</i>
<i>robustus</i>	<i>morio</i>	<i>sulcatus</i>	

Group II. Small mountain forms with large nostrils.

<i>townsendi</i>	<i>nasalis</i>
<i>pennatulæ</i>	<i>picadoi</i>

Group III. Species with fully webbed toes, almost all low country forms.

<i>altamazonicus</i>	<i>platydactylus</i>	<i>salvini</i>
<i>atitlanensis</i>	<i>lignicolor</i>	<i>yucatanus</i>
<i>striatulus</i>	<i>colonnus</i>	<i>rufescens</i>

Group IV. Wormlike forms, low country species with elongate bodies and weak limbs, usually lacking sexual dimorphism and the basal constriction of the tail.

<i>lincolns</i>	<i>complex</i>	<i>uniformis</i>
<i>collaris</i>	<i>porvipex</i>	<i>alfaroi</i>

* *gadowii* is not placed in a group, but had it been considered would probably be here.

If we examine Group I, we will observe that it is composed of an association of at least three widely different generic groups. Each of these has a different type of foot, and one group differs also in having the sublingual fold absent. *Adspersus* may even represent a fourth generic group, since it is said to lack a prefrontal and is reported to be ovoviviparous.†

In his Group II are again associated forms belonging to at least three widely differing generic groups. These, however, have in common an enlarged nostril. *Nasalis* is a member of the same generic group as *chiroptera* of Group I; *pennatulus* is a *Thorius* and his *townsendi* has no close relatives. I do not know *picadoi* by autopsy and I am uncertain of its generic reference.

In Group III we find species which have greater warrant for the association and probably are all referable to the same genus.

His Group IV includes six elongate forms, and while all are apparently quite distinct from other generic groups, may consist of more than a single genus. However, Dunn states, in speaking of *collaris*, "Has no near relatives. Remotely allied to *parvipes*, *collaris* is like it a link between the mass of the genus and the forms which have been considered *Oedipina*. The distinction is broken down and I can no longer regard the latter genus as tenable." I am not clear what breaks down the distinction.

Concerning *parvipes* he says, "This animal breaks down the distinction between *Oedipus* and *Oedipina*. It is related to the more degenerate *alfaroi* of Costa Rica. The small eye, the long snout, the brown color, are the same in both. But *alfaroi* has 20 costal grooves as against 17 in *parvipes*, and there are no teeth on the maxilla."

If we examine some of the other presumed "links" which are supposed to connect the various groups we will find that some other interpretation is possible. For an example, it is presumed that *Thorius* was regarded as being linked to "*Oedipus*" by the discovery of *Oedipus townsendi*. That this does not obtain is shown by an examination of the forms that constitute the genus *Thorius*, in which we find the following characters held in common: Skull very poorly ossified; maxillary toothless; prevomers in contact anteriorly; frontal processes of premaxilla pass along the prevomerine suture; parietals widely separated by membrane; orbitosphenoids widely separated from parietals and frontals; premaxillary fontanelle re-

† Dunn apparently has the erroneous impression that the species of *Oedipus* are ovoviviparous. *Adspersus* is the only one that to my knowledge has been so described. See Dunn 1926 "Plethodontidae," pp. 47, 48.

duced, a deep orbitolabial groove. *Oedipus townsendi* agrees in none of these characters. It has a series of enlarged dorsal glandules, the maxillary has a large series of pleurodont teeth; frontal processes of the premaxillary do not pass along the common prevomerine suture; skull bony; the parietals forming a common suture; orbitosphenoid in contact with parietal and frontal; a well-developed premaxillary fontanelle; no orbitolabial groove. It differs also in numerous other characters. The species does, however, agree with *Thorius* in that both are small, and have a free tongue and large nostrils. In consequence of these differences it is absurd to regard "*Oedipus*" *townsendi* the connecting link between the genus *Thorius* and "*Oedipus*," or *Thorius* and any other known generic group; or that it would be necessary for it to become extinct in order to recognize *Thorius* as a genus. The differences between *Thorius* and *Oedipina* are likewise equally as significant as those which obtain between *Thorius* and "*Oedipus*" *townsendi*.

Since Dunn does not state the articular variations which are to be found in the genera which he recognized in the plethodontids, one may presume that the data and material available to him were inadequate for him to make use of this character in delineating the genera; nor was he aware, apparently, of other vertebral characters which seem to be invariably present in given genera, and which might serve as additional discriminating characters between genera. Moreover, the presence or absence of a sublingual fold has either been overlooked or has been given no weight; adequate weight has not been given to the foot and hand characters, the differential characteristics of the premaxilla, the relationship of other skull bones, and the presence or absence of the prefrontal bones. The size of the nostril has perhaps been given more importance than it merits, since seemingly the large nostril may develop independently in unrelated genera or within a single genus, and of itself may not show other than ecological relationship.

In the specific treatment, Dunn has confused several species, misidentified some, and incorrectly synonymized others, and not impossibly, his erroneous grouping may be in part due to these errors. I have not as yet examined all the material seen by him. There are possibly other errors of identification than those listed here.

1. *Oedipus belli*.‡ Confuses *belli*, *gigantea* and *gadovii*. The

‡ The reference, p. 358, *Geotriton belli* Garman states "p. 471." This is incorrect. The page is 39, and the combination as such is not used. The name *S. belli* appears in a list under a genus, *Geotriton*.

latter is separated in the addenda as a distinct species. The synonymy of *bellii* still includes such references as apply to *gadovii*.

2. *Oedipus sulcatus*. This is not *Spelerpes sulcatum* Brocchi. The figure given by Brocchi shows a diminutive form having the fingers and toes more or less grown together (syndactylous). The specimens Dunn refers to this species are *smithi* (Taylor). I have elsewhere called attention to his error in the description (p. 260) which states "13 costal folds between adpressed toes." His statement, p. 33, "*sulcatus* from western Mexico," is incorrect. The actual type locality is unknown. Specimens which Dunn believed to be this form were from eastern Oaxaca.

3. *Oedipus chiropterus*. Dunn has referred the following numbers to *chiropterus* erroneously: M. C. Z., 3404 = *leprosus*; 8408 = *cephalicus*.

4. *Oedipus townsendi*. Dunn has confused two forms, *townsendi* and *dimidiata*. The specimens listed as cotypes from Hidalgo are of the latter species.

5. *Oedipus pennatulus*. Confuses four species: *Thorius nariso-valis*, U. S. N. M., 47608; *T. pulmonaris*, U. S. N. M., 47797; *Thorius pennatulus*; and U. S. N. M., 30348, consisting only of a head, which is not of this species or genus, but a sharp-snouted species, perhaps an *Oedipina*.

6. *Oedipus cephalicus*. Confuses specimens of *Spelerpes leprosus* Cope, *Spelerpes cephalicus* Cope, *Oedipus* sp., *Spelerpes chiroptera*, and *Bolitoglossa nigropunctata* Taylor, with this species.

U. S. N. M., No. 123592, sp. unidentified, is certainly not *cephalica*. U. S. N. M., No. 6340 = *Bolitoglossa nigropunctata*, two specimens. M. C. Z., Nos. 8417, 8418, 8420, 8421, 8423, 8426, 8427, 8431, are *leprosa* (only a part of this series, M. C. Z., 8417-8432, seen). I originally assigned these to *Oedipus orizabensis*. An examination of a large collection from Orizaba shows only a single form, there being some difference in specimens from low and high elevations. I am considering these all as *leprosus*. Nos. 8419, 8424, 8428, 8429, and 8430 are *Pseudoeurycea cephalica*. No. 8432 is *Chiropterotriton chiroptera*.

7. *Oedipus salvini*. Confuses *Oedipus flaviventris* with this form (*fide* Schmidt, 1936).

8. *Oedipus attitlanensis* is a synonym of *Oedipus salvinii* (*fide* Schmidt, 1936).

9. *Oedipus altamazonicus*. Confuses *Spelerpes peruvianus* Boulenger with this form. *Peruvianus* is a distinct form (*fide* Parker, 1939).

10. *Oedipus adspersus*. A. M. N. H., Nos. 13058-9 and A. M. N. H., Nos. 10330-9, referred to *adspersus*, are not of that species.

11. *Oedipus morio*. According to Schmidt, specimens referred by Dunn to this form belong to a different species, *Oedipus dunni* Schmidt.

12. *Oedipus lignicolor*. Refers A. M. N. H., 21370 (y.g., 33 mm. in length) to this form. It is an *Oedipina complex* with 17 costal folds.

13. *Oedipus yucatanus*. Confuses *Spelerpes doffleini* with this form; *doffleini* is distinct from *yucatanus*. (Fide Stuart, 1943).

14. *Oedipus platydactylus*. Confuses *Spelerpes mulleri* and *Bolitoglossa mexicana* with this species. These two forms, *mulleri* and *mexicanus*, are distinct. (Fide Schmidt, 1936 and Stuart, 1943).

15. *Oedipus rostratus* Dunn = *Oedipus morio* Cope. (Fide Dunn in Schmidt, 1933).

DISCUSSION OF GENERIC CHARACTERS

Foot and hand. Type I. The typical, primitive, unmodified, terrestrial forms have the digits unwebbed beyond the metatarsals or metacarpals, while certain more specialized ones may have the first phalanges partly or wholly included in the web. The phalanges are more or less hourglass-shaped, elongate, and the terminal ones are more or less widened at the tip. The phalangeal formula is normal and the digits are freely movable individually, while the terminal adhesive pads and the palm and sole are not strongly specialized. This group comprises a number of high mountain forms, and a few that tend to descend the sides of the plateau to lower elevations (in one case, that of *nigropunctata*, to less than four thousand feet). These species occupy territory from Nuevo León, to the central and southern parts of the Mexican plateau, and extend into Central America. Probably the oldest generic group of the family, the various species or species groups display greater differentiation one from another than those in other similar generic groups. Representatives of these generalized forms are *leprosus*, *altamontana*, *bellii*, *smithi*, *gadovii*, *goebeli*, *cochranae*, *galeanae*, *unguidentis*, *melanomolge*, *robertsi*, etc.

Type II. In the foot structure of this type, the digits of hand and foot are widespread, the subdigital termination bearing small, discrete, terminal pads which are truncate or, rarely, slightly pointed. The palm and sole are in the nature of a thick smooth pad which includes the proximal phalanges and the entire first toe and finger.

The digits are not, or but moderately, widened. In the young the nostrils are very large, a character which may or may not be retained in the adults. Some of the forms are terrestrial (*dimidiata*, *chiroptera*, *terrestris*, *chondrostega*, *mosaurei*), some arboreal or bromeliophilous (*arborea*, *nasalis*, *larvae*, *xoloccalcae*) and at least one both terrestrial and arboreal (*multidentata*), and they are chiefly high

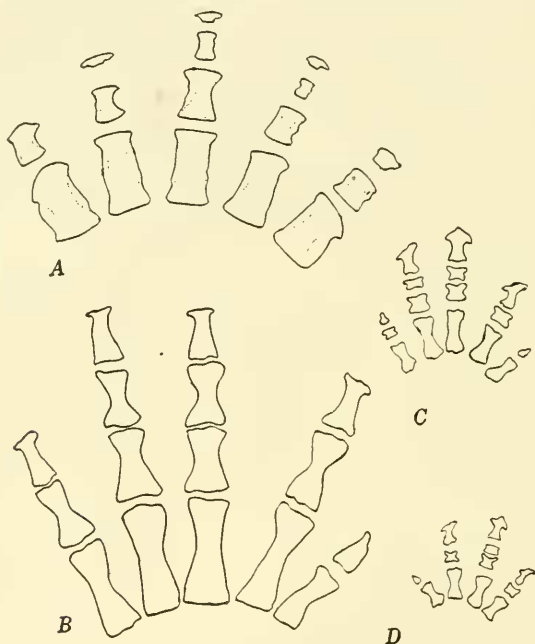


FIG. 1

- A. *Bolitoglossa flaviventris* (Schmidt).
Metatarsals and phalanges of foot. (Foot type III.)
- B. *Pseudoeurycea leprosa* (Cope).
Metatarsals and phalanges of foot. (Foot type I.)
- C. *Thorius narisovalis* Taylor.
Metatarsals and phalanges of foot. (Foot type V.)
- D. *Thorius narisovalis* Taylor.
Metacarpals and phalanges of hand. (? Foot type V.)

mountain dwellers. Species having hands and feet of Type II have a distribution from Nuevo León, México, south to Central America over the eastern part of the plateau.

Type III. A third type of foot and hand is present in a group of species which are chiefly Central American in distribution but with one or two representatives in the southern part of México. In this type the toes themselves are much widened and often sharply trun-

cate, the two middle digits being relatively shortened. The sub-terminal digital pads and the thick pad on sole and palm are reminiscent of those described in the preceding group. However, I do not regard the two types as representing close relationship since the groups (general) differ from each other in other fundamental characters, such as the absence of the sublingual fold, and the presence of typical amphicoelous vertebrae in that having the Type III foot. It may be presumed that any similarity between them is due to environmental circumstances which have brought about parallel de-

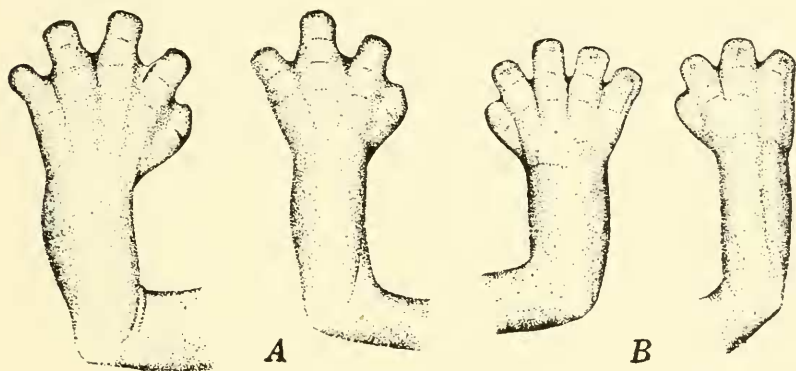


FIG. 2

A. *Magnadigita dunni* (Schmidt).

Foot and hand (enlarged). Field Mus. No. 4550, type. These represent typical hand and foot forms of *Magnadigita*.

B. ? *Magnadigita adspersa* (Peters).

Foot and hand. Amer. Mus. Nat. Hist. No. 13061.

velopment. However, Types II and III are readily distinguishable, the one from the other, and likewise, from other types here considered. Examples of Type III are *machrinii*, *nigroflavescens*, *flavimembris*, *robusta*, *dunni*, etc.

Type IV. A fourth group has the foot and hand completely or almost completely palmate, leaving only the extreme tips of the digits extending beyond the thick "web." In this group the digits may or may not be capable of independent movement. In undisturbed specimens the "web" is thick and is a continuous part of the pad that covers the sole and palm and includes the digits. In captured specimens when there has been much secretion from these pads, the "web," as such, is more evident. In some of the species, the individual digits are scarcely discernible exteriorly. On dissection certain of the phalanges are found to be shortened and

widened, the widening the result of the growth of a bony web along each side of the hourglass-shaped bone. The bony phalangeal formula may appear reduced since the terminal phalanges may be represented by only a minute cartilage. Members of this group are normally bromelicolus and their presence on the ground is for the most part accidental or temporary. It may be presumed that this type of foot is most efficient in moving over the smooth-leaved bromelias and plaintains; and likewise it has permitted the development of the larger arboreal forms. Examples of this group are *platydactyla*, *mexicana*, *flaviventris*, *lignicolor*, *yucatan*, *salvinii*, *rufescens*, etc.

Type V. It is not so easy to explain a fifth modification which involved the fusion of the digits for a part or the whole of their length, the digits themselves not being involved in a palmate pad, but retaining their individuality. Sometimes the types are rounded and partially free, sometimes sharply pointed at their terminations, and fused almost to their tips. With variations, this foot type is present in several small generic groups. The members are terrestrial or fossorial, living under leaves, rocks, or tending to burrow in rotting logs and detritus of various types. Generic examples are *Batrachoseps*, *Oedipina*, *Thorius*, etc.

Accepting the presumed aquatic origin of the plethodontids as fact, it would appear that webbing of the digits did not develop in response to the swimming stimulus, since the tail and not the limbs was the chief primitive organ of locomotion. The feet of salamanders with aquatic habitats usually are but little modified.

On land, however, a number of factors may be involved in changing the character of hand and foot. One might postulate that the winds which are responsible for the distinct wet and dry season are the remote stimulus for the development of the "webbed" foot in many of the salamanders. The winds prevent rain and tend to bring about a lack of surface moisture. This drives the salamanders to occupy, perhaps first, thick clumps of grass, terrestrial bromeliads and bromelia-like plants which can collect water, and then later, as they become still more modified by increase in the adhesive pads, to occupy the arboreal species of the families of water collecting plants.

The terminal phalanges of the unwebbed, relatively narrow-toed forms usually have a slight terminal widening, often described as "T-shaped." This widening may be absent on certain of the toes, the bone assuming the shape of a modified claw. This widening likewise is present in the partly webbed groups.

It would appear that the "webbing" is brought about by an increase in the number of small glands, which push along the digits and between the digits. This "web" provides a greater glandular surface for hand and foot so that the animal is enabled to ascend trees and climb about on smooth-leaved plants which hold moisture or collect it during the dry season. Usually the glandular web is not movable, and the digits of the hand and foot are kept continually widespread, apparently largely incapable of independent movement.

Sublingual fold. The sublingual fold appears in certain genera, and is absent in others. Its presence may have something to do with the ancestral condition, where the tongue is normally attached throughout life. Thus in certain very young specimens of a species, free-tongued in an adult state (removed from the egg), it appears that the tongue is attached. In *Haptoglossa* the tongue remains attached in the adult, as is likewise true of *Batrachoseps*, and the raised line of attachment is seemingly equivalent to the fold of the free-tongued forms. The character of the fold itself differs somewhat in the different genera of both free-tongued forms and those with attached tongues, in which it is present.

In at least a part of the genera having the tongue attached anteriorly (*Batrachoseps*) there is a distinct sublingual fold, and the attachment is along the median part of the fold for a greater or lesser distance. In *Eurycea*, in which the tongue is free, the fold is present in most if not all the species (all not examined). In *Pseudotriton* the membranes of the floor of the mouth are ample but the sublingual fold is scarcely represented in certain forms. The reduction of the membranes of the floor of the mouth and the complete absence of the fold seems especially significant in the genera *Bolitoglossa* (*sensu stricto*), and in *Magnadigita*, a genus herein described.

Intervertebral articulation. The vertebral articulation present in fully developed specimens of the salamanders under discussion fall into three general classes: amphicoelous, intermediate, and opisthocelous. In the amphicoelous type, the intervertebral notochordal material, always present in the embryo, remains as embryonic protocartilage, or is replaced by true cartilage. Usually when the vertebrae are separated, the greater part of the cartilage adheres to the anterior part of a centrum. If the animal is macerated, or is allowed to rot, the cartilage disintegrates completely, leaving two cone-shaped cavities in the ends of the centrum.

In the intermediate class there is some calcium deposited in the

cartilage, and this adheres to the deeper part of the cup, or may fill up the entire cup to the posterior level of the centrum. This is a progressive process, the younger specimens showing less deposit than very old specimens.

In the true opisthocoelous type, the entire intervertebral cartilaginous mass becomes calcified (or ossified) and is attached to the anterior part of a centrum, filling the entire cup of the centrum and also forming the ball, of a ball and socket joint, for articulation with the preceding vertebra. In younger specimens the deposition may not fill the cup and in still younger specimens the material may be cartilage. Thus unless a knowledge of the size and age of a specimen in relation to the normal maximum of the species is known, conclusions based on vertebral articulations are apt to be misleading, as might be true of any animal with an adult bony skeleton, since the young might show much more cartilage. However, if one is able to examine old adult specimens, there is as great a specific and generic constancy in vertebral articulation as obtains in any character.

The use of the vertebral articulations as a basis for discrimination between the families Desmognathidae and Plethodontidae was criticised by Percy Moore* because he had noted that certain salamanders which in early stages may be amphicoelous are strictly opisthocoelous in old age. On the basis of the literature he regarded the character of vertebral articulation as the only significant difference between the families. He therefore decided that the family PLETHODONTIDAE and DESMOGNATHIDAE should be united because "the failure of the only important character which has seemed to make the family distinction of the PLETHODONTIDAE and DESMOGNATHIDAE desirable renders their separate continuance no longer necessary."

Dunn, apparently misled in a measure by the Moore paper, erroneously makes a wide application to any "systematic division." His statement is,† "Moore in 1900 showed that the difference between amphicoelous and opisthocoelous was a matter of individual age, and that systematic divisions based on this character were worthless."

If we agree that species and genera are "systematic divisions," the above statement is not wholly true since Moore's findings do show that certain genera (genera established on other characters) may or do have fixed, old-adult characters as regards vertebral articulation. Thus, he points out the following facts (Moore, p. 618).

* Proc. Acad. Nat. Sci. Philadelphia, 1900, pp. 613-622.

† The Salamanders of the Family Plethodontidae, p. 38.

Hemidactylium always strictly amphicoelous.

Plethodon (four species) amphicoelous.

Autodax (one species) biconcave.

Oedipus variegatus [= *Bolitoglossa platydaetla*] biconcave, but "the anterior cup about one-third filled with calcified cartilage."

Gyrinophilus porphyriticus opisthocelous, the anterior cup filled or with the calcification extending beyond the rim of centrum.

Spelerpes bellii [= *Pseudoeurycea bellii*] amphicoelous, but with a possibility that it may change later in life (as it does not agree with the development in the three forms of *Spelerpes*). [*bellii* actually belongs to a different genus.]

Spelerpes longicaudus [= *Eurycea longicauda*], *Spelerpes bilineatus* [= *Eurycea bislineata*] and *Spelerpes guttolineatus* [= *Eurycea longicauda gutto-lineata*] opisthocelous (the anterior cups filled and with only a slight concavity).

Skeletal characters. Many if not all of the individual species segregated on the basis of the foot characters, presence or absence of the sublingual fold, and the characters of the vertebral articulations, may likewise show other skeletal characters in common which point to generic relationships. Thus in the group having the Type II foot, one may observe that the parasphenoid has a characteristic lateral notch; the orbitosphenoid is narrowed posteriorly, then suddenly widens to its greatest width anterior to the middle, then again becomes gradually narrower anteriorly; the brain case is wider in proportion to length than in certain other groups.

Certain of the generic groups have the dorsal ridge on the vertebrae well developed; in others it is low; while in still others scarcely a trace remains.

In certain of the genera there are no small lateral spines or "wings" on the side of the posterior part of the centrum, while they are present in two of the groups.

One genus *Oedipina* has a broad winglike bony development extending from the transverse processes along the posterior part of the vertebra.

I cannot distinguish any of the groups by the characters of the ribs or the transverse processes, yet some differences are present when individual ribs or individual vertebrae are compared. Contrary to Dunn's statement,[‡] the ribs are, with few exceptions, forked

[‡] Dunn states, "The ribs like those of Salamandridae and Ambystomidae, are forked distally" (p. 44, "The Salamanders of the Plethodontidae"). The ribs of the Salamandridae and Ambystomidae are likewise forked proximally.

proximally and not distally. Only the ribs of the second and third vertebrae may be also forked distally, that is, forked at both ends.

Dental characters. For the most part, the maxillary teeth of the southern plethodontids are pleurodont in character. However, in one genus, having the completely palmate hand and with the sublingual fold entirely missing, the teeth arise from the flat surface of the bone, rather than from along the edge of the maxilla. The teeth are relatively small and weak, reduced in number, and in two forms are apparently completely absent in adults.

With the exception of this group, there is constancy in the presence or absence of the maxillary teeth. In *Thorius* they are invariably absent in the known species, and invariably present in the other generic groups under consideration.

The maxillary teeth are normally in a single row in most of the genera save that in *Batrachoseps* there may be several rows present.

Prevomerine teeth are in one continuous row in most species; however, in younger specimens of certain species, in both young and adults of others, there may be several short rows which give the teeth a grouping often designated as a "patch." This condition appears in certain species of *Batrachoseps*, and is present in *Bolitoglossa yucatanica* and occasional *Bolitoglossa platydactyla*. Some specimens of *Pseudoeurycea cephalica* likewise may have the prevomerine teeth in a patch.

The teeth, widely known as "parasphenoid teeth," appear on two bony plates which are loosely attached to the undersurface of the parasphenoid. These plates are generally regarded as backward growths of the prevomers and in some genera remain unseparated from them, as continuous processes of the prevomers. However, in most genera they form two separate bones which bear larger or smaller series of teeth. The name *paravomers* for these separate elements has been suggested to me by Dr. Hobart M. Smith, a suggestion which I shall follow.

These bones are variable in width, sometimes narrow, widely separated, and having several very short diagonal rows of teeth, sometimes much widened, so that the two plates are continuous, bearing several long diagonal rows of teeth, the rows from the two bones tending to meet mesially and together forming a pattern of chevrons. When the specimens are allowed to macerate, these plates separate readily from the parasphenoid, since they are not sutured to the parasphenoid or to each other. The teeth themselves rot away at their bases and are lost, since the tooth base is not solid dentine or dentine and enamel like the remainder of the tooth.

When the paravomerine teeth are described as forming a single "patch," one must know that they are merely the same two groups (normally forming two series) that have become closely approximated.

The width of the paravomers is apparently not a generic character in all cases, as several of the generic groups outlined previously may have these tooth groups separated in some of the larger members and closely approximated in certain of the more diminutive species. In certain other generic groups there is constancy in the character of their close approximation.

The sexual differentiation in the tooth characters is marked, at least in adults. Practically all the species have dental dimorphism which in the males results in larger teeth on maxilla and more especially the premaxilla. In a large number of cases the males have a smaller number of teeth on maxilla, premaxilla, and mandible. The dimorphism is either absent or less obvious as applies to the paravomerine and prevomerine teeth. As has been frequently pointed out, the premaxillary teeth of males often pierce the gums, and are visible even when the lips are closed. Moreover, the actual shape of the teeth, as well as the size, may differ in the two sexes. Some species may have the tooth tips darkened, some blackish, some reddish in color.

GENERIC GROUPS

Of the genera herein discussed, *Bolitoglossa*, *Pseudoeurycea*, *Chiropetrotriton*, *Magnadigita*, *Parvimolge*, and *Oedipina* have the following characters in common: Digits, four anterior, five posterior; teeth invariably present on the paravomers, mandibles and premaxilla; premaxilla single; a fontanelle present between the frontal processes of the premaxilla and frontal; choanae open through a notch in the prevomers, no ossified pterygoids or pterygoid process on the squamosal or quadrate; otic capsule (periotic) never divided into two (or more) bones; occipital condyles sessile; operculum present; no bony septomaxilla. Tongue and hyoid apparatus attached to ventral surface of pelvis by two greatly elongate, narrow muscles; uniform hyoid apparatus; tongue boletoid, free; a nasolabial groove; carpals and tarsals of cartilage; lungs absent; frontal processes of maxilla never suturing or fusing behind fontanelle; atlas with two small spines on centrum, the anterior process ("odontoid process") with two articulating surfaces; eyes normal; no palmar tubercles; a specialized glandular area behind insertions of hind limb in both sexes; sexual dimorphism indicated by papillae in male cloaca, folds

in females; a submental (hedonic) gland in males; subnasal region more inflated in males; females usually larger, the body slightly longer in proportion to length of limbs.

The characters by which the genera vary are: the presence or absence of the prefrontal; character of maxillary teeth; presence or absence of a sublingual fold; character of feet, indicating adaption to terrestrial, subterrestrial, semiarboreal or bromeliad life; degree of ossification and relationship to each other of various bones of the skull; crests, wings or spines on dorsal vertebrae; the character of vertebral articulation (amphicoelous, opisthocoelous, or intermediate).

Too few of the characters of *Haptoglossa* have been given to compare it fully with the above group of genera. The fact that the tongue is not free sets it apart from *Thorius* and the above group of genera.

Thorius differs from the preceding group of genera in the foot characters; presence of an orbitolabial groove; separated parietals; absence of maxillary teeth; median part of brain case membrane; some forms with ossified carpals and tarsals; otic capsule and mandible rather well ossified while many other skull bones remain either cartilage or very weakly ossified; vertebrae opisthocoelous with rounded, anterior, articular condyles; fontanelle between frontal and frontal process of premaxillary, reduced.

Batrachoseps, also entering the Mexican fauna, has multiple tooth series on maxilla, digits 4-4, tongue not free; parietals, widely separated, the median part of brain case membrane; frontal processes of premaxillary fused, or not, the fontanelle reduced or absent; septomaxilla present (*vide* Dunn); no prefrontal; vertebrae preceding the sacral vertebra more than 15.

PSEUDOEURYCEA genus novum

Genotype *Spelerpes leprosus* Cope

Characters. Middle digits of hand and foot free beyond the metatarsals and metacarpals or at most involving the proximal phalanges; vertebral articulation intermediate, the cavity of the anterior part of centrum may be filled to the posterior surface of centrum, but lacking any trace of a rounded, terminal condyle; teeth on maxilla, premaxilla and mandible, pleurodont; premaxilla single, the frontal processes arising from a slight elevation on premaxilla; a well-defined fronto-premaxillary fontanelle; columella absent from the operculum; parasphenoid lacking a lateral notch; no septomaxilla; no lateral spines or "wings" on the posterior parts of centra (save atlas); a sublingual fold present.

Referred species. The species referred to this genus fall into several groups which are of almost generic character. These are:

GADOVII GROUP

Pseudoeurycea gadovii (Dunn)

Pseudoeurycea unguidentis (Taylor)

Pseudoeurycea melanomolge (Taylor)

SMITHI GROUP

Pseudoeurycea smithi (Taylor)

CEPHALICA GROUP

Pseudoeurycea galeanae (Taylor)

Pseudoeurycea cephalica cephalica (Cope)

Pseudoeurycea cephalica manni (Taylor)

Pseudoeurycea cephalica rubrimembris (Taylor & Smith)

BELLI GROUP

Pseudoeurycea belli (Gray)

Pseudoeurycea gigantea (Taylor)

LEPROSA GROUP

Pseudoeurycea altamontana (Taylor)

Pseudoeurycea cochranæ (Taylor)

Pseudoeurycea robertsi (Taylor)

Pseudoeurycea leprosa (Cope)

Pseudoeurycea nigromaculata (Taylor)

Pseudoeurycea goebeli (Schmidt)

Pseudoeurycea rex (Dunn)

?*Pseudoeurycea barbouri* (Schmidt)

The range of this genus extends from Zacatecas and Nuevo León

PLATE XII

- FIG. 1. *Pseudoeurycea gadovii* (Dunn). Hand and foot. EHT-HMS, No. 17176, topotype; Orizaba Volcano, 11,000 ft.
- FIG. 2. *Pseudoeurycea robertsi* (Taylor). EHT-HMS, No. 12503, type; Nevada de Toluca, México.
- FIG. 3. *Pseudoeurycea smithi* (Taylor). Hand and foot. EHT-HMS, No. 3966, type; Cerro San Luis N. W. Oaxaca, Oaxaca.
- FIG. 4. *Pseudoeurycea altamontana* (Taylor). Hand and foot. EHT-HMS, No. 12245, type; Lake Zempoala, Morelos.
- FIG. 5. *Pseudoeurycea cephalica cephalica* (Cope). Hand and foot. EHT-HMS, No. 12098, Lake Zempoala, Morelos.
- FIG. 6. *Pseudoeurycea leprosa* (Cope). Hand and foot. EHT-HMS, No. 12215, near Río Frío, México.
- FIG. 7. *Pseudoeurycea gigantea* (Taylor). Hand and foot. MCZ, No. 8437, type; Jalapa, Veracruz.
- FIG. 8. *Pseudoeurycea goebeli* (Schmidt). Hand and foot. EHT-HMS, No. 29879, paratype; Volcan Tajumulco, Guatemala.

PLATE XII



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south on the Mexican Plateau, two forms, *rex* and *goebeli*, occurring in Guatemala. Only one species, *Pseudoeurycea bellii*, is known to occur in the Sierra Madre del Sur in Guerrero, where it is the only known salamander.

The genus *Pseudoeurycea* has undergone its greatest development in the plateau region of México, practically no part of which lacks a representative (with the possible exception of the most north-western part). At least five subgeneric groups are present, and usually only one species of any given group occurs in a given locality. Thus in the general region on and about Mt. Orizaba one species belonging to each of four groups occur: *Pseudoeurycea gadovii*, *cephalica cephalica*, *gigantea* and *leprosa*. On Mt. Popocatepetl three groups, represented by four species, *bellii*, *cephalica cephalica*, *leprosa* and *altamontana* occur. On Cerro San Felipe, Oaxaca, *bellii*, *unquidentis*, *smithi* and *cochranae* are found—four species representing four groups. On Nevado de Toluca, in western México (state), *robertsi*, *bellii* and *cephalica cephalica* occur—three species and three groups.

Thus in only one case (Mt. Popocatepetl) do we find two species of one group represented—that *leprosa* and *altamontana*. The two forms also occur together in the Ajusco range (Lagunas de Zempoala).

On the periphery of the range, in the north only *cephalica galeanae* has been found; to the west in Jalisco, Zacatecas, and south in Guerrero only *bellii*; in lower elevations in the east (Veraacruz) only *nigromaculata* is known to occur.

When the internal anatomy of the *leprosa* group is better known, the differences between *altamontana* and *leprosa* may be found to be greater than they now seem to be. In Guatemala it has not been shown that *rex* and *goebeli* occur together.

Oedipus barbouri Schmidt is referred to this genus with a question. The toes are free. Whether the sublingual fold is present has not been ascertained.

CHIROPTEROTRITON genus novum

Genotype *Oedipus multidentata* Taylor

Characters. Small mountain salamanders adapted to both terrestrial and arboreal life. Hand and foot widespread, the proximal phalanx of each digit included in the fleshy web; under surface of digit tips with discrete, rounding, elevated pads, thickest posteriorly; first finger and first toe almost completely included in web; the last finger and toe well developed; palm and sole a glandular pad which is smooth, not showing the metatarsals and metacarpals. Tongue free with a membranous semicircular sublingual fold below anterior part of tongue (or somewhat anterior to it). Young with much enlarged nostrils, retained in certain adult forms. Teeth typically pleurodont on maxillary, premaxillary and mandible; paravomerine tooth patches either separate or closely approximated and forming a single patch; mandible usually not strongly ossified; carpals and tarsals of cartilage; metatarsals, metacarpals and phalanges well ossified; phalanges hourglass-shaped; terminal phalanges with a narrow or a wider, T-shaped termination.

The following characters are also common to most if not all the species. The premaxilla is single and is usually well ossified, narrow, bearing from seven to nine teeth; the frontal processes arise separately and pass up and back, separated from the skin by a thin mass of glands; the processes are attached to the nasals and frontals, and border a fontanelle lying partly between the anterior ends of the frontals and the processes; maxillaries and mandibles always toothed. Prevomers separated anteriorly, sutured only posteriorly, usually at about the level of the posterior edge of the choanal opening, touching the edge of premaxilla narrowly, widely separated from frontal or premaxillary processes. Paravomerine teeth on parasphenoid in two groups, narrowed somewhat anteriorly, and close together, wider and more separated posteriorly. Orbitosphenoid widest medially, narrowing at both ends, bordered above by the frontal and parietal, ventrally by the parasphenoid; optic foramen large, usually its diameter equal to half the posterior width. Frontals and parietals forming median sutures. Otic capsules (periotic) well

PLATE XIII

- FIG. 1. *Chiropterotriton bromeliacea* (Schmidt). Hand and foot. EHT-HMS, No. 27090, paratype; Volcan Tajumulco, Guatemala.
- FIG. 2. *Chiropterotriton chiroptera* (Cope). Hand and foot. EHT-HMS, No. 4475; km. 67, México-Puebla Highway, México.
- FIG. 3. *Chiropterotriton lavae* (Taylor). Hand and foot. EHT-HMS, No. 28937, type; 2 mi. W. La Joya, Veracruz.
- FIG. 4. *Chiropterotriton arborea* (Taylor). Hand and foot. EHT-HMS, No. 16734, type; near Tianguistengo, Hidalgo.
- FIG. 5. *Chiropterotriton nasalis* (Dunn). Hand and foot. EHT-HMS, No. 27286, paratype; mountains above San Pedro, Honduras.
- FIG. 6. *Chiropterotriton multidentata* (Taylor). Hand and foot. MCZ, No. 14812, paratype; Alvarez, San Luis Potosí (8,000 ft.).
- FIG. 7. *Chiropterotriton xolocae* (Taylor). Hand and foot. EHT-HMS, No. 25331, paratype; Cerro Ovando, Chiapas.

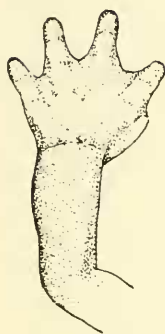
PLATE XIII



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ossified, lacking crests or spines but with three low, elongate, dorsal ridges, forming a triangular dorsal depression; lachrymal foramen between prefrontal, maxillary and nasal; operculum a flat plate, from the edge of which arises a short columella. Fifteen vertebrae precede the sacral vertebrae; no dorsal crests present and no spines on centra save on sides of atlas; atlas not modified.

Referred species. Besides the genotype, *Chiropterotriton multidentata* (Taylor), the following species are referred to the genus:

<i>Chiropterotriton chiroptera</i> (Cope)	<i>Chiropterotriton terrestris</i> (Taylor)
<i>Chiropterotriton dimidiata</i> (Taylor)	<i>Chiropterotriton larvae</i> (Taylor)
<i>Chiropterotriton chondrostega</i> (Taylor)	<i>Chiropterotriton zolocae</i> (Taylor)
<i>Chiropterotriton mosaueri</i> (Woodall)	<i>Chiropterotriton nasalis</i> (Dunn)
<i>Chiropterotriton arborea</i> (Taylor)	<i>Chiropterotriton bromeliacea</i> (Schmidt)

Remarks. The terrestrial types are *chiroptera*, *dimidiata*, *chondrostega*, *terrestris*, *mosaueri* and *multidentata*. The first mentioned form, *chiroptera*, is found most frequently under pine and other logs or in the crevices of rotting wood, under rocks, clumps of grass and piles of leaves. I have never taken the species in either terrestrial or arboreal bromelias. However, there are usually no, or but few bromelias in the regions, and at the elevations, where the species is most numerous. The species has been taken most frequently at from 9,000 to 12,000 feet elevation. In the region of the Lagunas de Zempoala, and elsewhere in the Ajuseo range in eastern México and western Puebla (Mt. Tlaloc, Ixtacehuatl and Popocatepetl) and east in the region of Cofre de Perote, Veracruz, this species is very numerous.

During the dry season this form finds shelter deep among rock piles, in the roots of rotting stumps and sometimes in the thick basal masses of the mountain grass clumps, which remain moist during much of the dry season. My first visits to the northern slopes of Cofre de Perote were made in June at which time the specimens were extremely numerous at Cruz Blanca. The place was visited later in the season on two or three occasions and not a single specimen could be found where literally thousands might have been collected earlier.

Chondrostega resembles *chiroptera* in most details but the skull is largely cartilaginous, the bones are extremely fragile (especially the vertebrae and limb bones), and the atlas is shortened. The foot shape is almost identical with that of *chiroptera*, and its habitat is likewise similar. The species has been found only in the general region about the type locality. None have been taken in bromelias—in fact no bromelias were observed in this immediate region.

Mosaueri occurs in this same locality but I suspect that this species is subterrestrial, living in the cavities in limestone rocks, which are

abundant in this region. The types were found in the mouth of a small cavern some feet below the ground.

Arborea and *terrestris*, two other members of the genus, occur in central northern Hidalgo and may actually be present in suitable localities in the same region where *chondrostega* and *mosaueri* occur. In the mountain region in southern Hidalgo two other forms, *multidentata* and *dimidiata*, occur, the latter known only from this range, the other, *multidentata*, occurring as far north as San Luis Potosí. I have seen an undescribed species of this genus that was taken on Cerro Potosí near Galeana, Nuevo León.

Chiropetrotriton lavae is known only from bromelias on the plateau edge in central western Veracruz, but I suspect it is likewise to be found in the lava rocks which occur in such abundance in the region. To the south a species, *xolocalcae*, has been recently discovered on Mt. Ovando, southern Chiapas. It is so far known only from the bromelias of this region. Still farther southeast *nasalis* occurs. This latter form apparently is also largely or entirely bromelia-inhabiting. It combines the character of small fingers and toes (similar to *chiroptera*) with a very large nostril.

Multidentata, occurring in the mountains of Hidalgo and San Luis Potosí, is a form that is both terrestrial and arboreal, and is apparently the most generalized form. During the wet season the greater number of specimens were to be taken on the ground, while a few only were to be found in bromelias. The elevation at which the species occurred most frequently was 9,000 to 11,000 feet. It differs from *chiroptera* in the retention of all or most of the maxillary teeth in the males (all but a few enlarged teeth are lost in *chiroptera* males), longer tail, longer limbs and a slightly wider skull. Proportionally the digital tips are very slightly wider than in *chiroptera*.

Arborea, *chiroptera* and *lavae* have a small number of enlarged teeth on the maxillaries of the males. The sublingual fold under the tongue (or slightly in advance of it) is always present. It may represent a line of lingual attachment in its ancestors. It is not to be confused with the membrane attaching the ceratobranchial heads, immediately anterior to the base of the tongue.

The evolution of this generic group has taken place largely in México. *Multidentata* appears to be a more generalized form and I suspect this or a related form may be ancestral to the group. The other species all may be regarded as more specialized. This specialization is largely evidenced by reduction in size, variation in dental characteristics (chiefly the size, shape and number of teeth). While

there is a variation in length of limb with relation to body length and size of foot, the general *shape* of the foot, its pads and its wide-spread character remain unchanged. The slight increase in the length of limb and width of the toes in *arborea* is an adaptation to a more complete bromeliad habitat. The paravomerine tooth groups are close together in *dimidiata*, *terrestris* and *chondrostega*, which may be a result of the small size of these forms.

When the Central American countries south of Guatemala are better explored herpetologically, it seems likely that the genus will be traced farther to the south than it is now known.

MAGNADIGITA genus novum

Genotype *Bolitoglossa nigroflavescens* Taylor

Characters. Digits wide, more or less truncate, the outer one or two phalanges greatly shortened and free. No sublingual fold; metatarsals, metacarpals and phalanges poorly ossified; prefrontals present, premaxilla single, the spines arising separately; vertebrae completely amphicoelous, the centra large, thin walled, with a lateral keel or wing on the side; maxilla toothed; tongue free; no septo-maxillae; occipital condyles sessile; carpals and tarsals cartilage; atlas with narrow winglike shelf along centrum instead of the two lateral spines, not obviously specialized; phalanges compressed, flattened, with some evidence of a lateral bony web. Usually (if not invariably) oviparous.

The foot pattern is held with rather rigid tenacity throughout the range, only that of *Magnadigita flavimembris* showing a slight departure from the typical (see Pl. XIV, fig. 8).

Referred species: Aside from the genotype *Magnadigita nigroflavescens* (Taylor), the following species are associated with this genus: *Magnadigita macrinii* (Lafrentz); *Magnadigita lincolni* (Stuart); *Magnadigita englehardti* (Schmidt); *Magnadigita rostrata* (Schmidt); *Magnadigita robusta* (Cope); *Magnadigita franklini* (Schmidt); *Magnadigita flavimembris* (Schmidt); *Magnadigita dunni* Schmidt; *Magnadigita cuchumatana* Stuart; ? *Magnadigita morio*; ? *Magnadigita adpersa* (Peters); ? *Magnadigita subpalmata* Boulenger. The three last species are referred here tentatively.

The Mexican species of this genus are confined to the southern part of the country, *Magnadigita macrinii* being known only from a range of mountains in southern Oaxaca, and *Magnadigita nigroflavescens* from Mt. Ovando in southwestern Chiapas. Other species range south through Central America and into South America.

BOLITOGLOSSA Duméril and Bibron

GENOTYPE *Bolitoglossa mexicana* Duméril and Bibron

Characters. Digits 4-5; feet and hands palmate, none or only tips of digits free; no sublingual fold; prefrontal present; premaxilla single, the spines arising separately; a fronto-premaxillary fontanelle; teeth on maxilla (normally) but these not typically pleurodont, but arising from flat surface of bone, and not at the edge (two forms lack teeth). Tongue free, but no trace of a sublingual fold; vertebrae completely amphicoelous; no bony septomaxillae; occipital condyles sessile; carpals and tarsals cartilage; metatarsals, metacarpals, and phalanges compressed, hourglass-shaped with lateral bony webs; phalangeal bony formula may be reduced (some of the terminal phalanges represented by cartilage only); oviparous; no aquatic stage; costal grooves 13, costal folds 12; 15 vertebrae precede the sacral vertebra; spines on sides of posterior part of centra; atlas not obviously specialized; paravomerine tooth patches on the parasphenoid closely approximated.

The species of the genus have greatly enlarged nasal capsules which extend in both sexes out over the upper lip. The premaxilla is single, reduced, weakly ossified, the base lying almost horizontal, the frontal processes pushing up between the nasal capsules near their posterior part; the nasal bones are relatively very large, generally triangular in shape, and may touch each other above the premaxillae. At least certain forms (*flaviventris*) have only eight carpals. The prefrontals are greatly reduced, but usually if not always form a part of the border of the lachrymal foramen; the choanae open through a notch in the prevomer.

Referred Species. Species are referred to the genus, as follows:

<i>Bolitoglossa colonnea</i> (Dunn)	<i>Bolitoglossa salvinii</i> (Gray)
<i>Bolitoglossa occidentalis</i> Taylor	<i>Bolitoglossa flaviventris</i> (Schmidt)
<i>Bolitoglossa helmrichi</i> (Schmidt)	<i>Bolitoglossa lignicolor</i> (Peters)
<i>Bolitoglossa rufescens</i> (Cope)	<i>Bolitoglossa yucatanica</i> (Peters)
<i>Bolitoglossa doffleini</i> (Werner)	<i>Bolitoglossa mexicana</i> Duméril and Bibron
<i>Bolitoglossa mulleri</i> (Brocchi)	<i>Bolitoglossa odonnelli</i> (Stuart)
<i>Bolitoglossa platydactyla</i> (Cuvier)	<i>Bolitoglossa borburata</i> Trapido

The following species are tentatively referred to the genus:

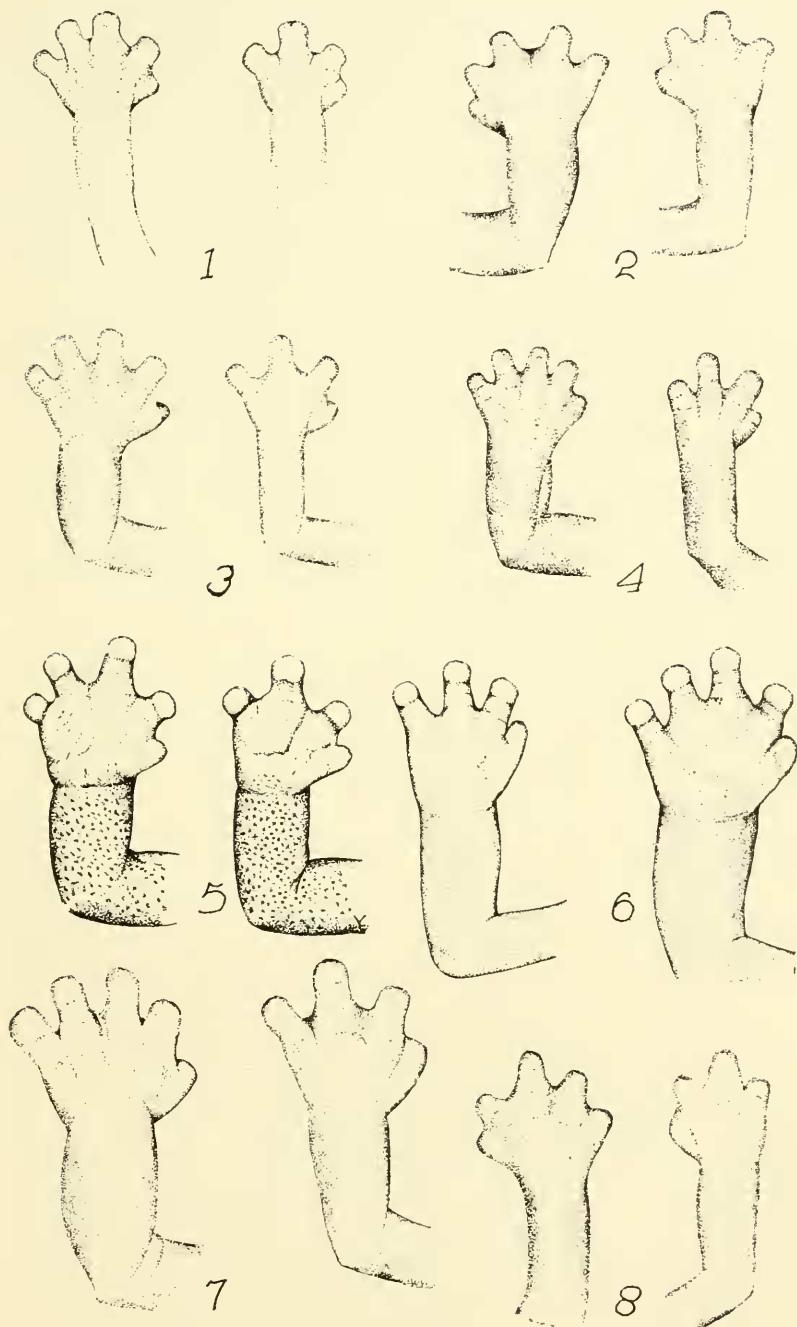
<i>Bolitoglossa schmidtii</i> (Dunn)	<i>Bolitoglossa ahli</i> (Unterstein)
<i>Bolitoglossa altamazonica</i> (Cope)	<i>Bolitoglossa paraensis</i> (Unterstein)
<i>Bolitoglossa peruviana</i> (Boulenger)	<i>Bolitoglossa striatula</i> (Noble)

Save for Noble's (1921) figure of "*Oedipus adspersus*" and his statements regarding the same, the skeletal anatomy of this second group of species is unknown to me. Noble's figure shows that the prefrontal bone is absent in *adspersus*. He states: "Very marked differences in the anterior cranial elements distinguish *adspersus* and

PLATE XIV

- FIG. 1. ? *Magnadigita macrinii* (Lafrentz). Hand and foot. AMNH, No. 6240; San Pedro Alta, Oaxaca.
- FIG. 2. *Magnadigita englhardtii* (Schmidt). Hand and foot. EHT-HMS, No. 27276; Volcan Atitlan, Guatemala.
- FIG. 3. *Magnadigita rostrata* (Schmidt). Hand and foot. EHT-HMS, No. 27285; above Tecpan, Guatemala.
- FIG. 4. *Magnadigita robusta* (Cope). Hand and foot. USNM, No. 37773, La Palma, Costa Rica.
- FIG. 5. *Magnadigita nigroflavesceus* (Taylor). Hand and foot. EHT-HMS, No. 27263; Cerro Ovando, Chiapas.
- FIG. 6. *Magnadigita lincolni* (Stuart). Hand and foot. UMMVZ, No. 89109; Monte at Salquil Grande, El Quiché, Guatemala.
- FIG. 7. *Magnadigita franklini* (Schmidt). Hand and foot. EHT-HMS, No. 27274; Volcan Atitlan, Guatemala.
- FIG. 8. *Magnadigita flavimembris* (Schmidt). Hand and foot. EHT-HMS, No. 27272, Volcan Tajumulco, Guatemala.

PLATE XIV



striatulus from *leprosus*. *Oedipus variegatus*, the type of the genus, is so closely allied to *O. striatulus* that it seems probable that these cranial patterns will be shown to be the same. The following characters common to *O. striatulus* and *O. adpersus* may be considered the distinguishing features of the *Oedipus* as now defined [by Noble]: "(1) no prefrontal; (2) no septomaxilla; (3) premaxillae ankylosed only at their extreme anterior ends."

From this one is led to believe that the prefrontal bone is absent also in *striatulus* and *variegatus* [= *B. platydactyla*] Cuvier. However, the prefrontal actually is present in the two latter species. I have not examined the former.

If Noble is correct in the identification of the specimen which he figured as *Oedipus adpersus*, there is very considerable doubt that the species belongs to any of the genera here defined.

The genus will doubtless eventually be divided into two or more subgenera. The most obvious division is between the larger, long tailed species, represented by *platydactyla*, and small short-tailed forms represented by *rufescens*.

The range of *Bolitoglossa* is along the eastern lowlands of México (to 3,500 ft. elevation) from eastern San Luis Potosí south through Central America and into South America.

Representatives of two groups of the genus occur in México.

Platydactylus has been traced to the north along the eastern lowlands as far as San Luis Potosí. East and south of the isthmus *mexicana*, *flaviventris* and *yucatana* occur. Two Mexican forms belonging to the group of smaller species are known. *Rufescens*, a toothed species, has a range similar to *platydactyla*. In the Pacific drainage south of the isthmus it is replaced by a closely related, toothless, species, *occidentalis*.

Representatives of the genus have been traced to the mouth of the Amazon in Brazil. The extent of the range of the genus in South America depends upon the final disposition of species tentatively referred to it.

The validity of the genus *Eladinca* Miranda-Ribeiro is in question. It was erected for a species described from embryos and newly hatched young, from the Utinga forest, Pará, Brazil, which he believed was different from other South American species in being oviparous. Parker (1939) believes that it may be the young of *Oedipus altamazonicus*. However it would be extremely difficult to draw a generic distinction on very young specimens. Neither Parker nor Miranda-Ribeiro have considered the possibility of a relationship with Unterstein's lowland forest species, *Oedipus paraensis* from Santa Isabel near the city of Pará (Belem), Brazil.

PARVIMOLGE genus novum

Genotype *Oedipus townsendi* Dunn

Characters. Diminutive salamanders, characterized by a series of much enlarged dorsal glandules arranged irregularly on each side of the median dorsal line. Skull well ossified; pleurodont teeth on maxillae; paravomerine teeth on parasphenoid in a single patch (2 very closely approximate series); frontal processes of premaxilla arising separately, very close together, not fused or sutured posteriorly; prefrontal absent; carpals and tarsals cartilaginous; phalanges normal; anterior part of centra cylindrical, acelous, but lacking rounded anterior condyles; no orbitolabial groove; fingers and toes fleshy, syndactylous, with the tips of the three middle toes and the outer fingers free and pointed rather than rounded; a sublingual fold present. (For foot type see pl. XV, fig. 2.)

Skeletal characters of Parvimolge townsendi (Dunn). The prevomers are closely approximated medially but not sutured, save posteriorly; the premaxilla bears seven teeth; the frontal processes, arising from an elevation on the upper part of the base premaxilla, very closely approximated and continuing close together to the frontals and enclosing a narrow fontanelle; frontals and parietals form a straight median suture. Otic capsule well ossified; the orbitosphenoid sutured to the parietal and frontal, the optic foramen large; mandible largely cartilage with one small and four or five very large teeth (at least in the male), extending above the level of the jaw a distance equal to the height of jaw itself. Vertebrae, 15 anterior to the sacrum; atlas not strongly modified, except that the body of the vertebrae is only a little longer than the "odontoid" articulating process. Body vertebrae lacking dorsal crests or spines; no lateral wings behind the transverse processes.

Referred species. Only the genotype, *Parvimolge townsendi* (Dunn).

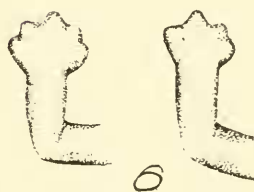
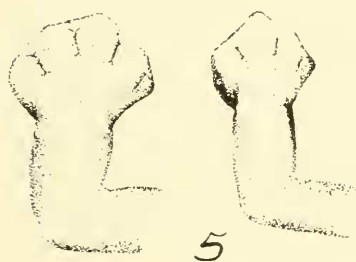
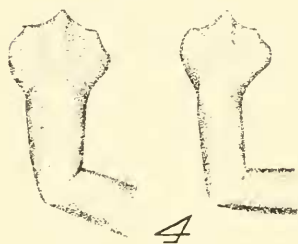
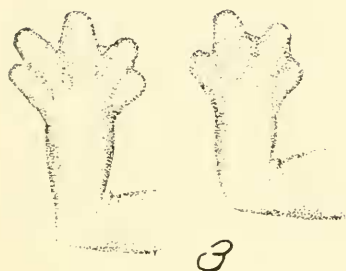
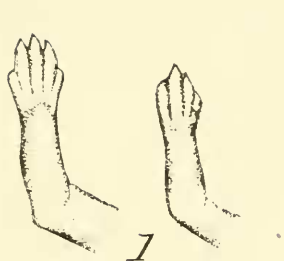
Remarks. This species lives in the same general region where *Thorius pennatulus* Cope occurs and is of about the same size. It may be readily distinguished from members of that genus, by the absence of the orbitolabial groove, the greater degree of cranial ossification, the enlarged dorsal glandules, the presence of the maxillary teeth, frontal processes of premaxillary not in contact with the prevomerine suture, prevomers forming a continuous suture, and the presence of cartilaginous carpals and tarsals.

Specimens from Guerrero, Hidalgo, which Dunn associated with *P. townsendi* as paratypes, belong in a different genus. These are

PLATE XV

- FIG. 1. ? *Oedipina complex* (Dunn). Hand and foot. AMNH, No. 40473; Barro Colorado I., Panamá.
- FIG. 2. *Parvimolge townsendi* (Dunn). Hand and foot. EHT-HMS, No. 26562, paratype; Jalapa, Veracruz.
- FIG. 3. *Bolitoglossus* ? sp. Hand and foot. AMNH, No. 10339; Bogotá, Columbia.
- FIG. 4. *Bolitoglossa occidentalis* Taylor. Hand and foot. EHT-HMS, No. 24049, paratype; Finca Juárez, Chiapas, México.
- FIG. 5. *Bolitoglossa mexicana* (Gray). Hand and foot. AMNH, No. 45339; Cofradia, Honduras.
- FIG. 6. *Bolitoglossa helmrichi* (Schmidt). Hand and foot. EHT-HMS, No. 27053; near Samac, west of Coban, Guatemala.
- FIG. 7. *Bolitoglossa flaviventris* (Schmidt). Hand and foot. EHT-HMS, No. 3995; Tonalá, Chiapas.
- FIG. 8. *Bolitoglossa platydactyla* (Cuvier). Hand and foot. EHT-HMS, No. 15202, near Córdoba, Veracruz.

PLATE XV



Chiropterotriton dimidiata Taylor. This form may be readily distinguished by hand and foot form, the presence of a prefrontal, no enlarged dorsal glandules on the back, etc., etc. Both have enlarged nostrils.

OEDIPINA KEFERSTEIN

Genotype *Oedipina uniformis* Keferstein

Characters. Elongate, slender-bodied terrestrial salamanders, the tail longer (usually very much longer) than head and body; digits largely or entirely syndactylous, the tips more or less pointed; a sublingual fold; 16 or more vertebrae preceding the sacral vertebrae, all with broad elongate alar expansions on the sides behind the transverse processes; no dorsal crests on body vertebrae, and no lateral spines on ventral or lateral part of centra.

Premaxilla somewhat ossified, rather narrow, rectangular; the frontal processes arising from a common elongate stem, and separated only narrowly; teeth on maxilla pleurodont; a prominent maxillary shelf; paravomerine tooth groups juxtaposed, appearing as a single patch; no orbitolabial groove.

Characters of Oedipina lineola Cope. Maxilla ossified, the teeth pleurodont, increasing in size toward premaxilla; premaxilla with two enlarged teeth in males, $1\frac{1}{2}$ times as wide as high; orbito-sphenoid forming sutures with parietal and frontal, widening a little in the middle; optic foramen relatively very small, about one-fifth the width of the bone on a level with the foramen; the paravomerine tooth series on the parasphenoid are very closely approximated, appearing as a single group; frontals and parietals ossified, forming a straight, median suture; carpals and tarsals cartilage; a fontanelle present.

The feet and hands have the basal part of the digits grown together but the two middle fingers and three middle toes are free for some distance; the toes are bluntly pointed. In the adult the tail is twice the length of head and body.

Referred forms. The following species are referred to this genus: *Oedipina uniformis* Keferstein, *Oedipina lineola* (Cope), *Oedipina complex* (Dunn), *Oedipina elongata* (Schmidt), *Oedipina parripes* (Peters), *Oedipina collaris* (Stejneger), *Oedipina alfaroi* (Dunn). See comment below.

Remarks. There is some doubt whether all the elongate wormlike forms of Central and South America are congeneric with *uniformis* and *lineola*. The skeletal characters of most of the group are unknown and there is a probability that an examination of the skele-

tons will prove that more than a single genus is represented. The more obvious external and dental differences of the seven forms are here shown. Grouped according to the presence or absence of maxillary teeth they may be separated as follows:

Maxillary teeth		No maxillary teeth
<i>uniformis</i>	<i>clongata</i>	<i>alfaroi</i>
<i>lineola</i>	<i>parvipes</i>	
<i>complex</i>	<i>collaris</i>	

When grouped according to snout shape the groups are as follows:

Blunt snout	Sharp snout
<i>uniformis</i>	<i>parvipes</i>
<i>lineola</i>	<i>collaris</i>
<i>complex</i>	<i>alfaroi</i>
<i>clongata</i>	

The absence of teeth may not be a generic character, but with few exceptions in amphibians, teeth are present in a given genus, or invariably absent in another. One exception to this in the plethodontids is recognized in the genus *Bolitoglossa*: *Bolitoglossa rufescens* is without, *Bolitoglossa occidentalis*, with maxillary teeth; *Bolitoglossa colonnea* is without maxillary teeth while the related *Bolitoglossa striatula* has them. An examination of the external and skeletal characters of the first pair of species show them to be very closely related.

The foot character of a specimen from Barro Colorado Island, identified as *Oedipina parvipes*, is different from *lineola* in that the digits are more entirely grown together; the toes are flattened and only the middle toe and the two middle fingers have the tips free; the digits for the most part terminate in sharp points.

This specimen has 17 costal grooves, the hind legs reaching about the length of four and one half costal folds, the arm, four folds, the digital tips being separated by six and one-half folds.

As now known, the genus *Oedipina* extends from central Veraacruz south through Central America into northern South America.

Only *Oedipina lineola* is known to occur certainly in México; and as far as collections go it seems to be confined to the low mountain slopes in western central Veraacruz. The specimens collected have been found chiefly in piles of chips, and under trash on the ground in the coffee and banana plantations.

The placing by Dunn of *Spelerpes (Oedipus) infuscatus* Peters (having 14 costal grooves, and purporting to come from Haiti) as a questioned synonym of *lineolus* may be warranted since *lineola* is

known to have 14 costal grooves and 13 costal folds. However, comparing the description of *infuscatus* with a specimen of *lineola* of the same size, (21 mm. snout-to-vent) the following differences obtain: Head width (2.48 mm.) in snout-to-end-of-vent length (21.2 mm.) 8.5 times, instead of 7 times. The arm reaches about half the distance between arm insertion and the corner of the mouth, instead of "almost to the corner of mouth;" the hind leg reaches forward beyond the middle of the 11th costal fold. Specimens of *lineola* of this size have the nostril still large, a character not noted in the description of *infuscatus*. The original description is very brief, and other differences may actually obtain. That *Spelerpes infuscatus* is a synonym of *Oedipina lineola* is not established beyond a doubt.

THORIUS COPE

Genotype *Thorius pennatululus* Cope

Characters. Very diminutive salamanders; tongue free with a sublingual fold present; a deep orbitolabial groove, running from eye diagonally back to lip; digit fused together at bases, the middle digits somewhat widened and rounded, and free at tips. Skull poorly ossified, the parietals not forming a median suture, separated by a membrane; orbitosphenoid widely separated by membrane from parietal and frontal; maxilla edentulous; mandibular and prevomerine teeth present; operculum with a minute columella fused to it; premaxilla single, very small, triangular, bearing from 1-3 teeth in males, the frontal processes arising from the base, separately, then apparently suturing, or at least continuing side by side to dorsal surface of skull where they again separate; processes in contact with prevomers along their mutual suture, thus completely separating the nasal capsules by bone; orbitosphenoid nearly rectangular, the optic foramen occupying one third of its width; paravomerine teeth on the parasphenoid in two closely approximated groups (appearing as a single-heart-shaped group); lower jaw well ossified; atlas greatly shortened, the "odontoid" articular process nearly as long as remainder of vertebrae; vertebrae completely opisthocoelous, the anterior part of centrum with a rounded condyle, lacking wings posterior to the transverse processes; 15 vertebrae precede the sacral vertebra; nostril large, varying from very large to moderately large in various species, carpals and tarsals ossified; none or but a small anterior fontanelle between frontal processes of the premaxillae.

Referred species. In addition to the genotype, *Thorius pennatululus*

Cope, the following four: *Thorius dubitus* Taylor, *Thorius troglodytes* Taylor, *Thorius narisovalis* Taylor, and *Thorius pulmonaris* Taylor.

Remarks. These diminutive salamanders are terrestrial. None have been found above the ground save that *Thorius narisovalis* occurs under the bark of fallen trees. Some of the species have the habit of coiling in a flat spiral. The presence of strongly ossified carpals and tarsals, and the deep groove from eye to mouth, separate these from all other genera in Mexico having a nasolabial groove. Apparently there are eight tarsals present. The five species known have a limited distribution in central western Veracruz, and in Oaxaca. A sixth and undescribed species occurring in northeastern Puebla has the nostril reduced in size. *Pennatulus*, occurring between three and four thousand feet elevation, is the smallest species; *Thorius narisovalis*, the largest species, occurs at still higher elevations, some up to 10,000 feet. I suspect that the genus has a much wider distribution than is known at present.

The skull shown by Cope, pl. XXXVII, Bull. 34, U. S. Nat. Mus., purporting to be *Thorius pennatulus*, is not the skull of any of the species of *Thorius* which I have examined. I strongly suspect that some error is involved. The presence of teeth on the maxilla, the much enlarged vomerine teeth, the absence of spines on the premaxilla, the suture of the frontal with the orbitosphenoid, all point to some other species, belonging to another genus.

The figure given by Boulenger (Catalogue of the Batrachia Gracientia s. Caudata and Batrachia Apoda in the collection of the British Museum, 2d Ed., 1882, p. 79, pl. III, fig. 2), is a species of some Mexican salamander which probably does not belong in this genus. The head is thick and there is no orbitolabial groove shown. The "dark lateral band white margined above," also suggests a species that is not a *Thorius*. It is very difficult to say what species is intended.

HAPTÓGLOSSA Cope

GENOTYPE *Haptoglossa pressicauda* Cope

Characters. "Tongue adherent in front and by the middle; digits not distinct, four anterior, five posterior; vertebrae opisthocelous; carpus and tarsus not* ossified."

Remarks. Dunn has synonymized *Haptoglossa pressicauda* with

* Cope may have intended to write "not cartilage" instead of not ossified, since the genus *Thorius* of his family THORIIDAE (THORINAE) with which he compares it has ossified carpals and tarsals.

Oedipus uniformis with the following comment. "Cope's *Haptoglossa pressicauda* is probably the present form. The type has been destroyed. The proportions, dentition, color, and indeed everything except "the tongue adherent in front and by the middle are so like those of young *uniformis* that I cannot help thinking they are the same. I include it in the synonymy with a query."

Cope in his description states that "This genus is of much interest as the first one discovered in Tropical America in which the tongue is not boletoid in form," and points out that "It seems also that the relation of this form of the western coast to those of the east coast of this group is the same in Costa Rica as that which prevails in North America. It is well known that no species of salamander, with a boletoid tongue, is found on the Pacific coast of North America." Since Cope has used the character of the attached tongue for the above comment, it seems very unlikely that his statement "tongue adherent" is a lapsus or due to faulty observation.

The species is a short tailed form, "Length of tail equals that of body without the head. Tail compressed from near base to apex, with a median dorsal but no ventral groove, and well-marked vertical grooves." Cope also points out that the species resembles *Thorius* and *Oedipina*, but that it differs from these latter in the shorter, compressed tail, as well as in the generic characters listed.

Since no species of *Oedipina* (or of "*Oedipus*") is known to have the tongue adherent, I believe Dunn's action in placing this form in synonymy, even with a question mark, wholly unwarranted. That the species has not been rediscovered is not surprising, since diminutive forms are very secretive, and special effort is necessary to find them.

SPECIES INCERTAE SEDIS

Two species, referred by Dunn (1926) to his genus *Oedipus*, *Spelerpes picadoi* Stejneger, and *Spelerpes sulcatum* Broochi, have not been referred to any of the genera defined here. Specimens of the former which I have been able to examine are in such a state that I cannot be certain of their affinity.

To the best of my knowledge no specimens of *Spelerpes sulcatum* save the type series are in collections. The final disposition of this species must await an examination of the type, and a study of the internal anatomy of the species.

NOTE.—Part II of this paper (to be published later in this journal consists of a comparative anatomical study of species of the various genera delineated here.

BIBLIOGRAPHY

BERTHOLD, ARNOLD ADOLPH.

- 1827 Latreille's natürliche Familien des Thierreichs aus dem Französischen mit Anmerkungen und Zusätzen, Weimar, 1827, pp. 1-x; 1-604.

BOULENGER, GEORGE ALBERT.

- 1882 Catalogue of the Batrachia Gradientia s Caudata and Batrachia Apoda in the collection of the British Museum, 2d Ed., 1882, pp. 51-79, pls. 1-30.

BISHOP, SHERMAN C.

- 1943 Hand book of salamanders, The Salamanders of the United States, of Canada, and of Lower California, Comstock Publ., Ithaca, N. Y., 1943, pp. 1-xiv; 1-555; figs. 1-144.

COPE, EDWARD DRINKER.

- 1869 A review of the species of the Plethodontidae and Desmognathidae. Proc. Acad. Nat. Sci. Philadelphia, 1869, pp. 93-118.

- 1889 The Batrachia of North America. Bull. U. S. Nat. Mus., No. 34, 1889, pp. 1-525, pls. 1-86, text figs. 1-119.

- 1893 Second addition to the knowledge of the Batrachia and Reptilia of Costa Rica. Proc. Amer. Phil. Soc., Vol. 31, 1893, pp. 333-347.

DUNN, EMMET REID.

- 1926 The Salamanders of the family Plethodontidae. Smith College Fiftieth Anniversary Publ., 1926, pp. I-viii, 1-441, 3 plates (unnumbered), maps 1-86.

MOORE, PERCY J.

- 1900 Post-larval changes in the vertebral articulations of Spelerpes and other salamanders. Proc. Acad. Nat. Sci. Philadelphia, 1900, pp. 613-622.

NOBLE, G. KINGSLEY.

- 1921 The anterior cranial elements of Oedipus and certain other salamanders. Bull. Amer. Mus. Nat. Hist., Vol. XLIV, 1921, pp. 1-6, pls. 1, 2.

PARKER, H. W.

- 1939 Résultats scientifiques des croisières du navire-école, Belge "Mercator." V. Reptilia et Amphibia, Mem. Mus. Roy. d'Hist. Nat., Belgique, Ser. 12, Vol. 2, fasc. 15, 1939, pp. 85-90, figs. 1, 2.

ROBERTS, H. RADCLYFFE.

- 1941 Nomenclature in the Orthoptera concerning genotype designations. Trans. Amer. Ento. Soc., Vol. LXVII, No. 1083, June 16, 1941, pp. 1-34.

SCHMIDT, KARL PATTERSON.

- 1933 New Reptiles and Amphibians from Honduras. Zoöl. Series, Field Mus. Nat. Hist., Vol. XX, Dec. 11, 1933, pp. 15-22.

- 1936a New amphibians and reptiles from Honduras in the Museum of Comparative Zoölogy. Proc. Biol. Soc. Washington, Vol. 49, May 1, 1936, pp. 43-50.

- 1936b Guatemalan salamanders of the genus Oedipus. Zoöl. Ser., Field Mus. Nat. Hist., Vol. XX, No. 17, October 31, 1936, pp. 135-166, figs. 13-19.

STUART, LAWRENCE C.

- 1943 Taxonomic and geographic comments on Guatemalan salamanders the genus Oedipus. Misc. Publ. Mus. Zoöl., Univ. Michigan, No. 56, Jan. 30, 1943, pp. 1-32, pls. 1, 2.

TAYLOR, EDWARD HARRISON.

- 1939 Concerning Mexican Salamanders. Univ. Kansas Sci. Bull., Vol. 25, No. 14, 1938 (July 10, 1939 first mailing), pp. 259-313, pls. 24-29.
- 1940 New Salamanders from Mexico with a discussion of certain known forms. Univ. Kansas Sci. Bull., Vol. 26, No. 12, 1939 (Nov. 27, 1940 first mailing), pp. 407-439, pls. 45-48, text figs. 1-5.
- 1941a New plethodont salamanders from Mexico. Herpetologica, Vol. 2, No. 3, March 25, 1941, pp. 57-65, text figs. 1-5.
- 1941b Two new species of Mexican plethodontid salamanders. Proc. Biol. Soc. Washington, Vol. 54, July 31, 1941, pp. 81-86.
- 1941c Herpetological Miscellany No. II. Univ. Kansas Sci. Bull., Vol. XXVII, Pt. 1, No. 7, Dec. 30, 1941, pp. 105-139, pls. III-VI, text figs. 1-7.
- 1941d New amphibians from the Hobart M. Smith Mexican collections. Univ. Kansas Sci. Bull., Vol. XXVII, Pt. 1, No. 8, Dec. 30, 1941, pp. 141-167, pls. VII-XI, text figs. 1, a-c.

TRAPIDO, HAROLD.

- 1942 A new salamander from Venezuela. Biol. Soc. Venezolana Cien. Nat., Tomo VIII, No. 51, April-June, 1942, pp. 297-301, fig. 1.

TSCHUDI, JOHAN JACOB, VON.

- 1938 Classification der Batrachier mit Berücksichtigung der fossilen Thiere dieser Abtheil. Neuschatel, 1838, pp. 1-98, pls. 1-6.

UNTERSTEIN, WALTER.

- 1930 Beschreibung zwier neuer Molche der gattung Oedipus. Zoöl. Anz., Bd. 87, Nr. 9 10, March 10, 1930, pp. 270-272.

WOODALL, HAROLD T.

- 1941 A new Mexican salamander of the genus *Oedipus*. Occ. Papers Mus. Zoöl., Univ. Michigan, No. 444, July 18, 1941, pp. 1-4.

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